THE CALIBRATION OF PHOTOGRAPHIC AND SPECTROSCOPIC FILMS

(NASA-CR-177830) THE CALIBRATION OF PHOTOGRAPHIC AND SPECTROSCOPIC FILMS: THE RESPONSE OF IIaO FILM TO SMALL DOSAGES OF ALPHA PARTICLES FROM 3/10TH'S RAD TO 8 RADS AT ENERGY LEVELS 153 MeV, 79 MeV AND 47 MeV N88-20668

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The Response of IIaO Film to Small Dosages of Alpha Particles from 3/10th's rad to 8 rads at energy levels 153 mev, 79 mev, and 47 mev.

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ABSTRACT

Pre-exposing IIaO film to a series of neutral density filters which upon development under standard conditions will produce the standard H-D curve for that film, which were exposed to Alpha particles with a dose range of 3/10th rads to 8 rads while varying the energy of the particles using 153 mev, 70 mev, and 47 mev respectively. An analysis of the film shows that the 3/10th rad dose produces the lowest optical density changes at 70 mev, and 47 mev. While the optical density readings for the darker patterns seem to oscillate and decrease when exposed to radiation dosages of 3/10th rads to 8 rads.

INTRODUCTION

With the utilization of special UV films on the Space LAB Mission and future SIT Missions of the Space Shuttle, it is important to understand the response of these emulsions to the enviornment of space where there exist particles in the solar wind, the ionosphere surrounding the earth and more energetic particles from the cosmos in general. It is a requirement to have some terrestrial analysis and calibration of that film after exposure to carefully controlled alpha particles using the Harvard University Cyclotron.

The film was pre-exposed using a sensitometer with a number 328 General Electric Lamp at 195 ma current. The sensitometer bulb

was given a 10-18 hour calibration burn-in time. The exposure time for each individual slide or wedge was ten seconds.

EXPERIMENTAL SET UP

The exposed IIaO film was incapsulated in a light-tight aluminum canister for placement in front of the portal of the Harvard University Cyclotron. Special consideration was raised concerning a light-tight portal so that the film would not have to be covered by aluminum foil as it was ultimately so incapsulated. The development of the film occurred immediately after the film canister had been exposed with the appropriate dose and predetermined calibration of the machine.

RESULTS

The total increase as per change in energy for certain obscurely chosen densities indicates that the higher energy particles for the same dose produce higher optical densities. While the perceptible difference between 79 mev and 47 mev is about the same. Therefore, a reduction in energy for the same dose will reduce the optical density reading on the film.

An examination of optical density versus the dosage for each of the energies: 153 mev, 79 mev, and 47 mev, indicates how the film responds to a very low level dose. It indicates that there is a slight increase in the density of the film for the higher energy dose at 3/10th of a rad. Figures #4, 5, and 6, clearly show a slower increase in the optical densities for dosages of 3/10 rad to 7 rads. Pattern number 8 for each of the energies: 153 mev, 79 mev, and 47 mev, tend to increase in densities, while pattern number 14 displays some decrease and at best some oscillatory

activity as the rad dosage increases. And, finally, an examination of the most dense wedge at the energies at 153 mev, 79 mev, and 47 mev, clearly show a decrease in optical densities with respect to the 79 mev and 47 mev runs. This observation is consistent for all of the data.

DISCUSSION

The interaction between the rad dosage and the individual energies of the alpha particles is a very complex phenomenon. But the data does indicate the relative limits of very low doses of alpha particles and it clearly demonstrates that the film is sensitive to subtle changes to energy and dosages. Using a 47 mev proton alpha particle and a difference of a 3/10 rad and 6/10 rad exposure there exists a ten percent increase in density. While an examination of 153 mev alpha particles for the same dosage difference produces an eleven percent increase in the optical density in the film. Further examination of the data will reveal other anomalies and particularities of the mix of proton energy rad dosage and optical density.

EXPOSURE EFFECTS FOR DOSAGES BETWEEN .3 RAD AND 6 RADS FOR 47, 79, AND 153 MEV'S RESPECTIVELY.

EXAMINATION OF THE FIRST 12 PATTERNS FOR VERY SMALL RAD DOSAGE CLEARLY INDICATES THAT THE SMALLER DIFFERENCES OCCUR IN THE PATTERNS FROM 3/10 OF A RAD TO 2 RADS TENDS TO INDICATE FOR EACH PATTERN EXAMINED AFTER 2 RADS, THERE IS A SUBSTANTIAL INCREASE IN THE OPTICAL DENSITY AS RELATED TO EACH PATTERN. ONE CAN SEE A SLIGHT SHIFT IN THE OPTICAL DENSITY AT 153 MEV'S WHILE THERE IS A PROPORTIONAL SHIFT FOR THE REMAINING PATTERNS AT EACH RESPECTIVE DATA.

fig. 1

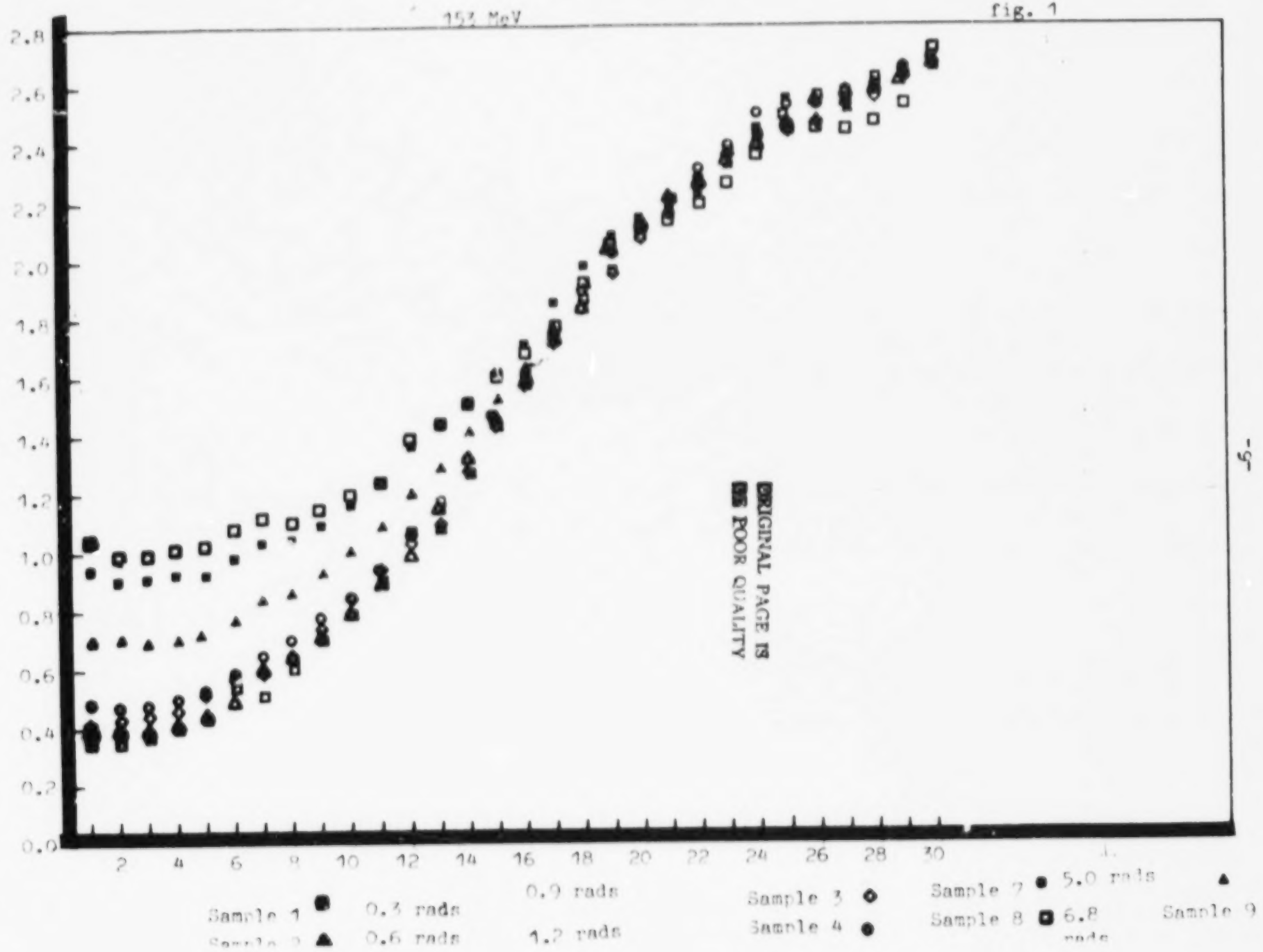

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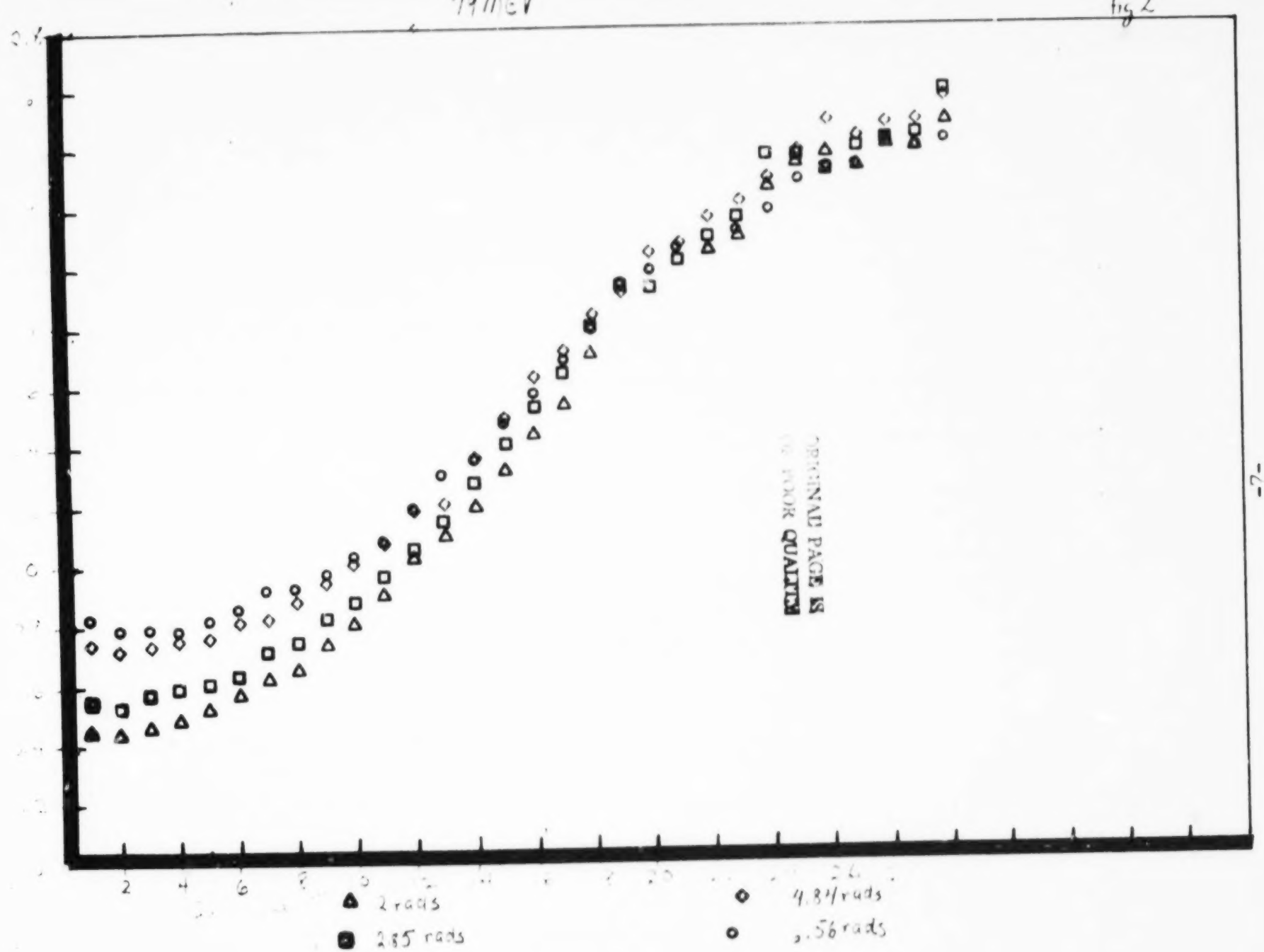
fig 2



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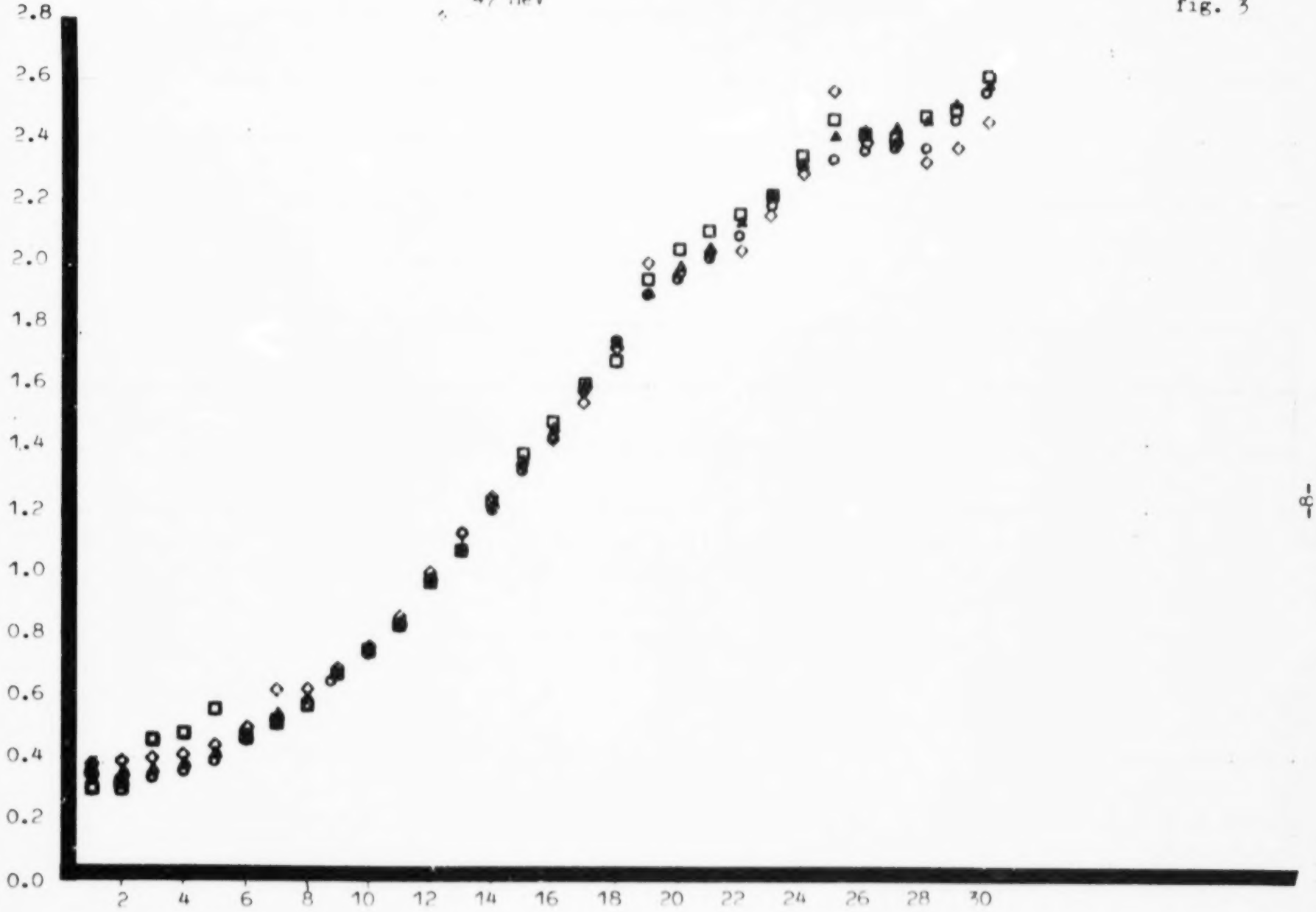
47 MeV

fig. 3


2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
Sample 21 0.29 rads
Sample 22 0.59 rads
Sample 23 0.88 rads
Sample 24 1.18 rads

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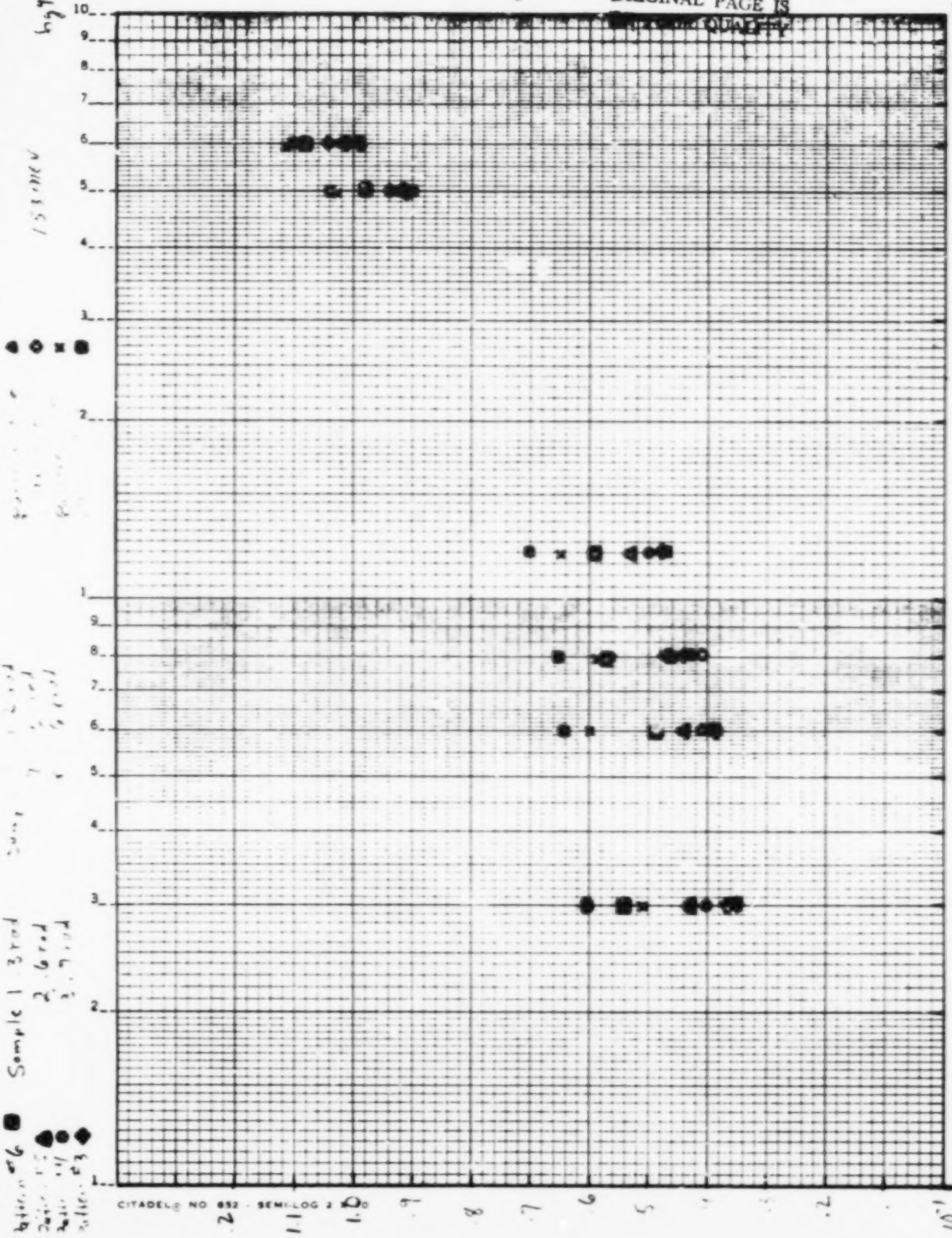

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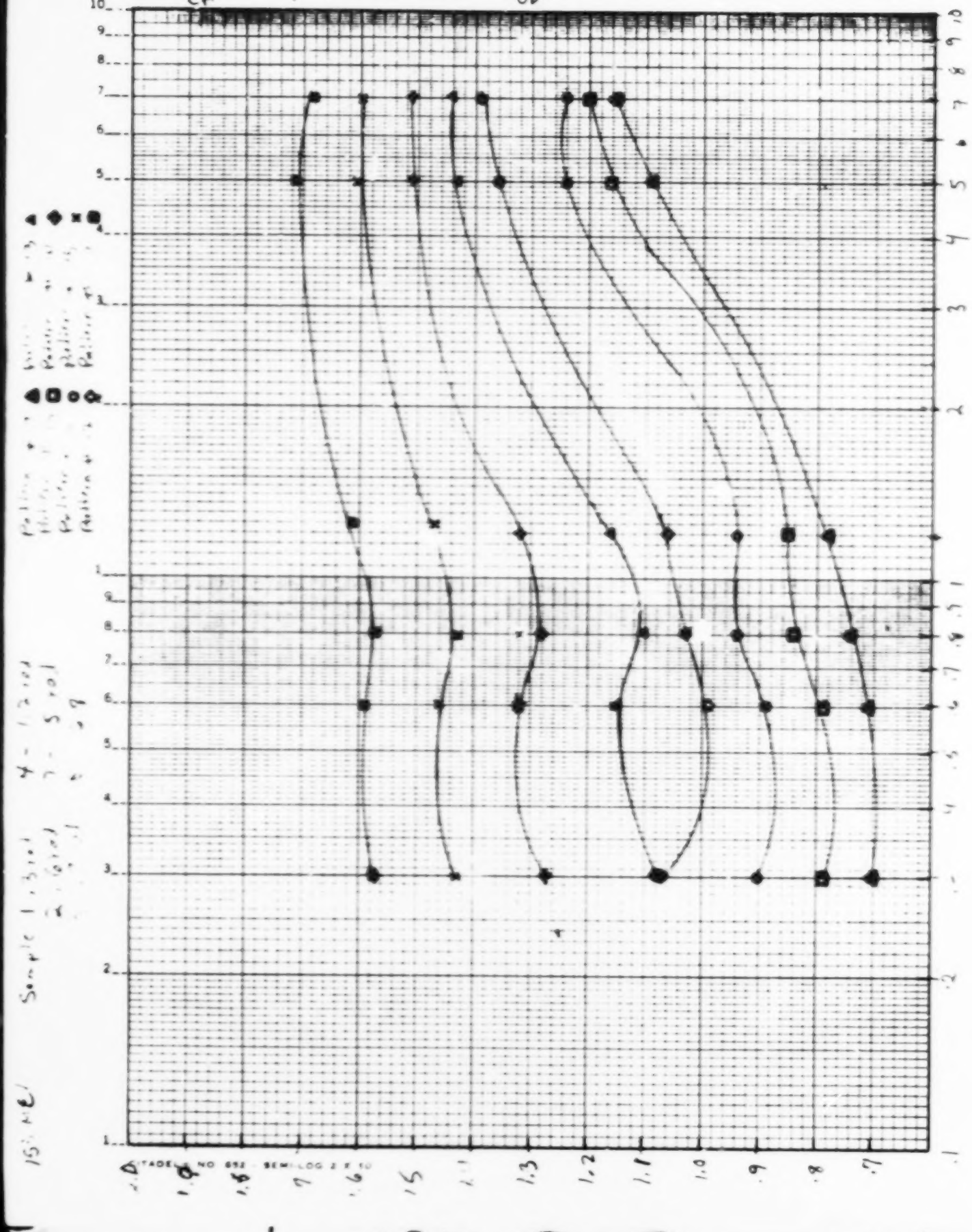

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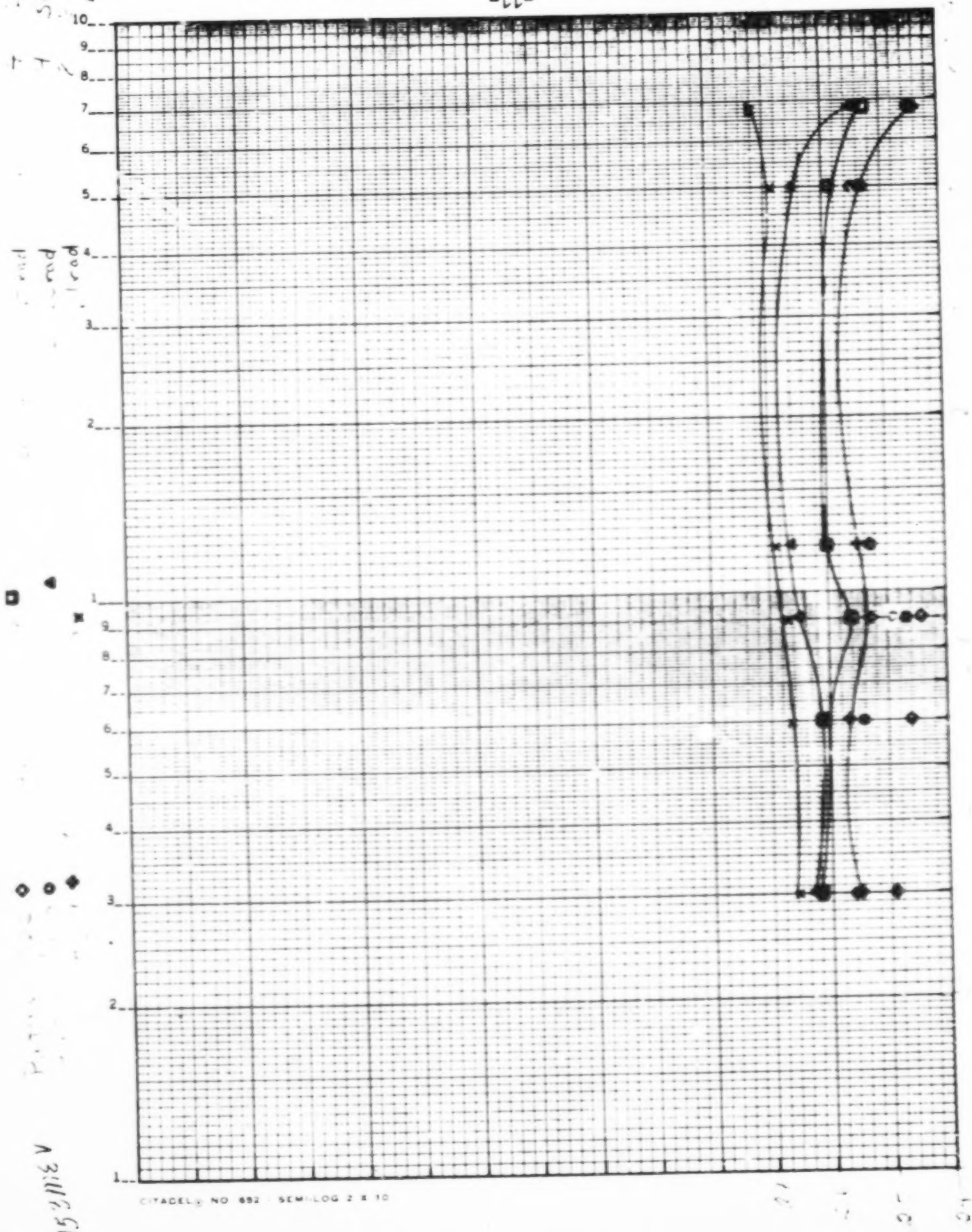

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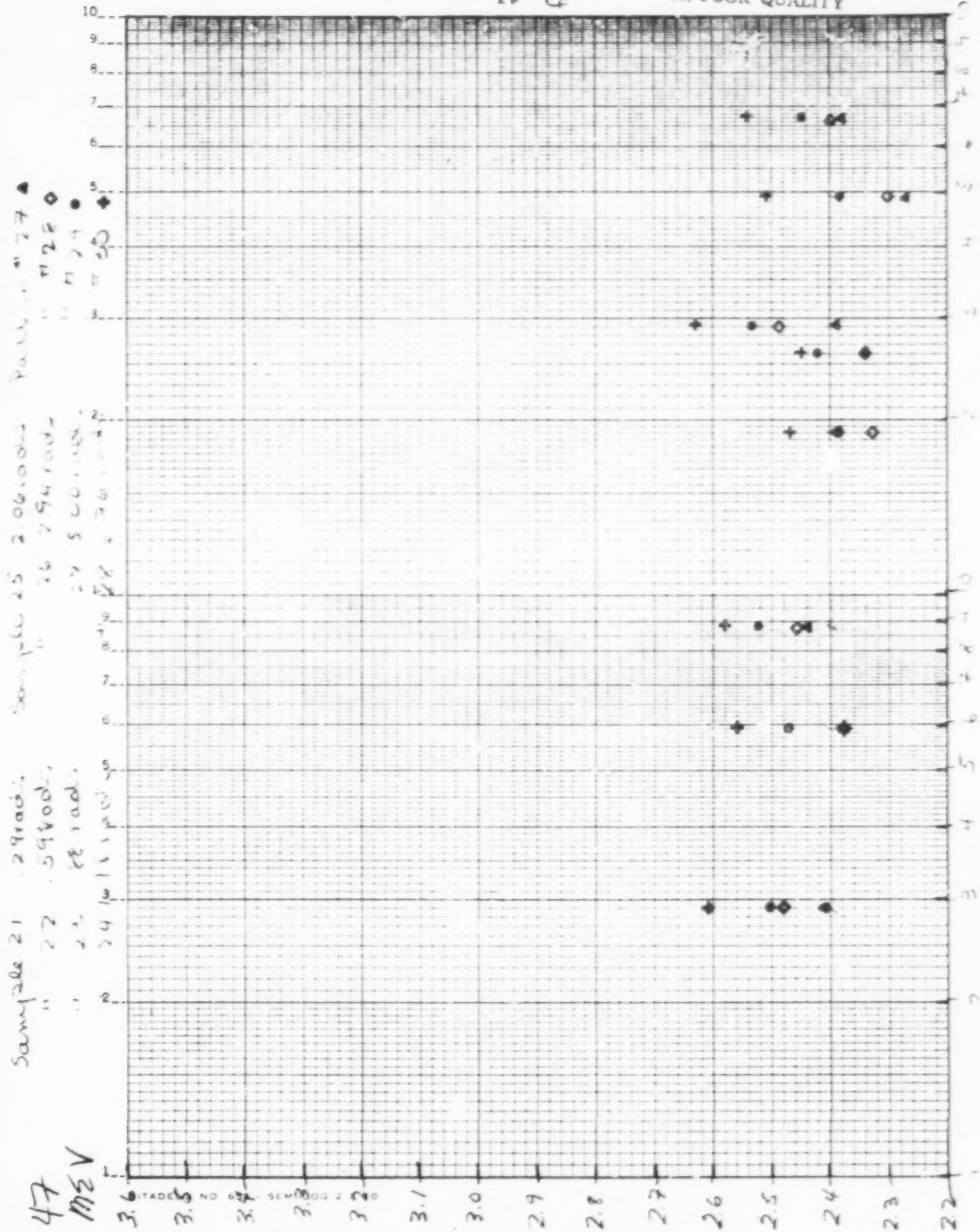

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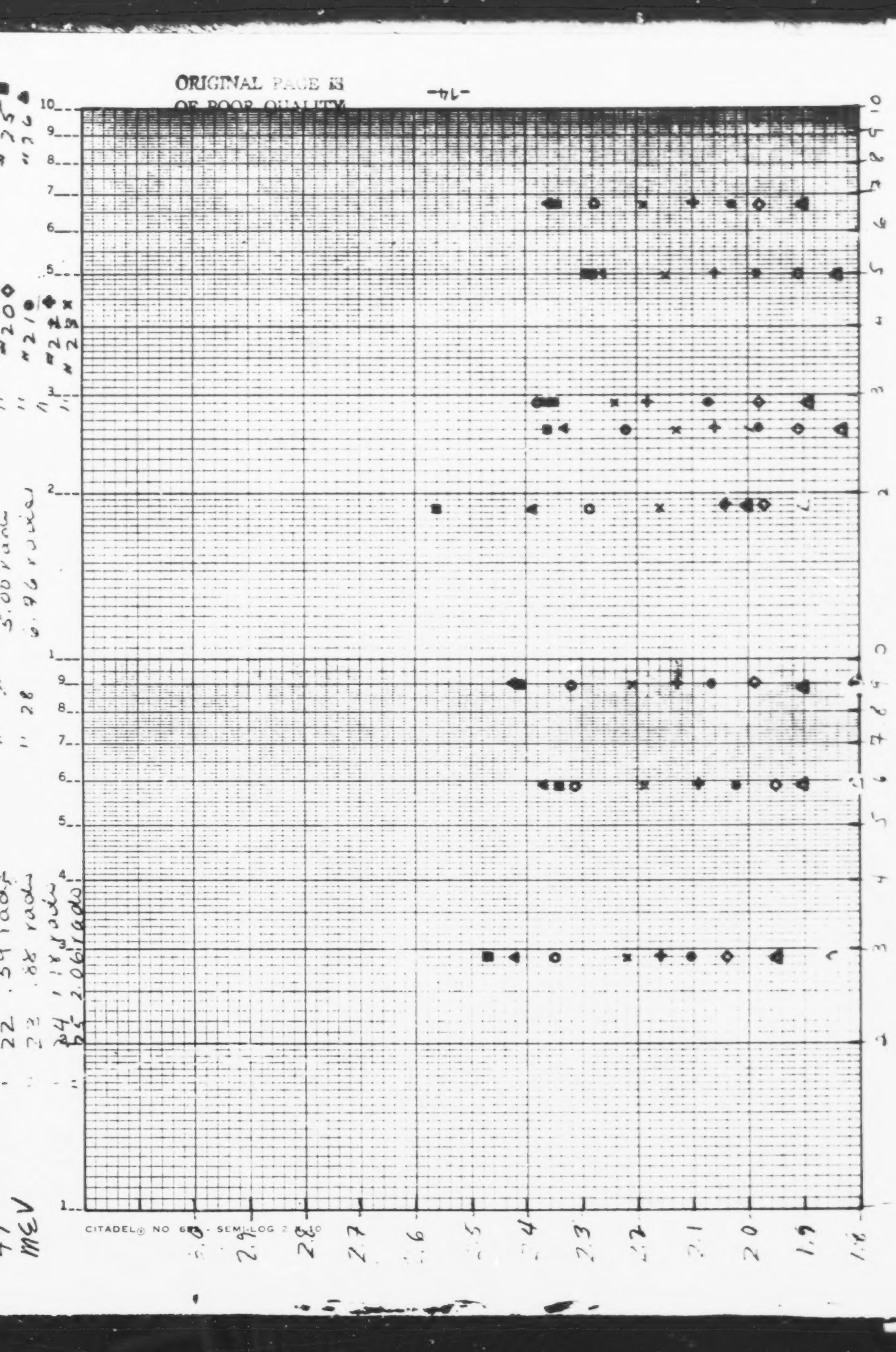

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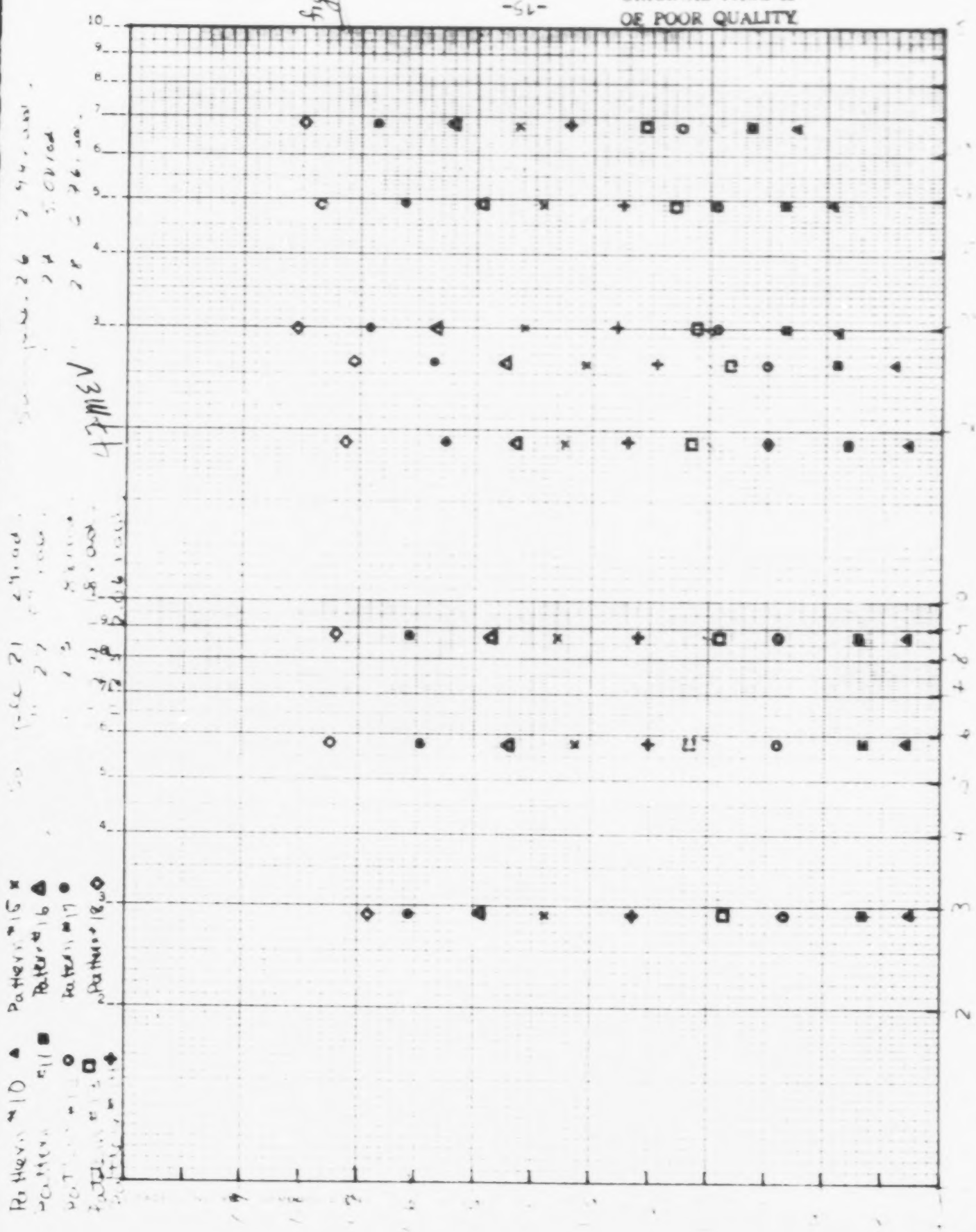
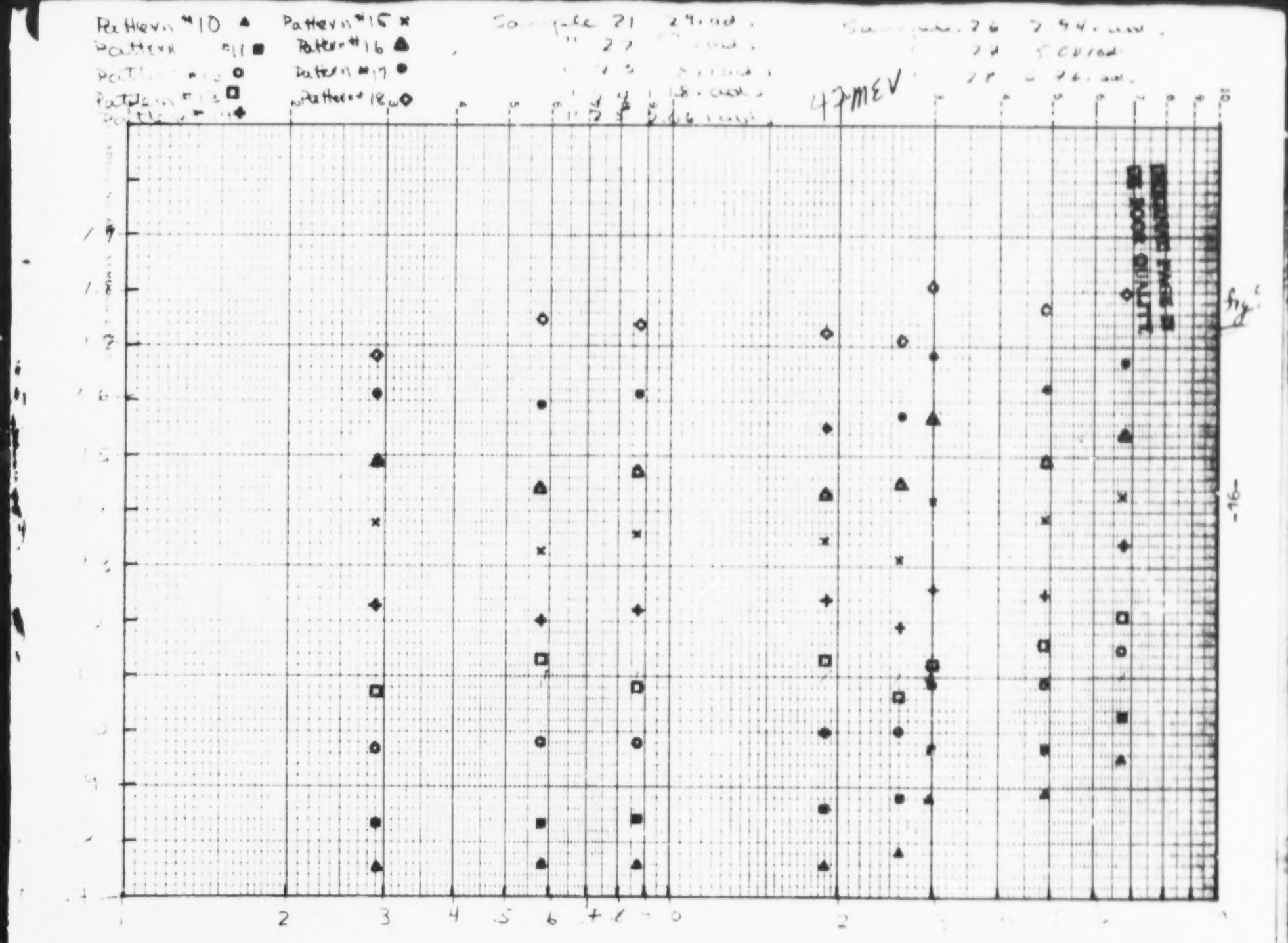
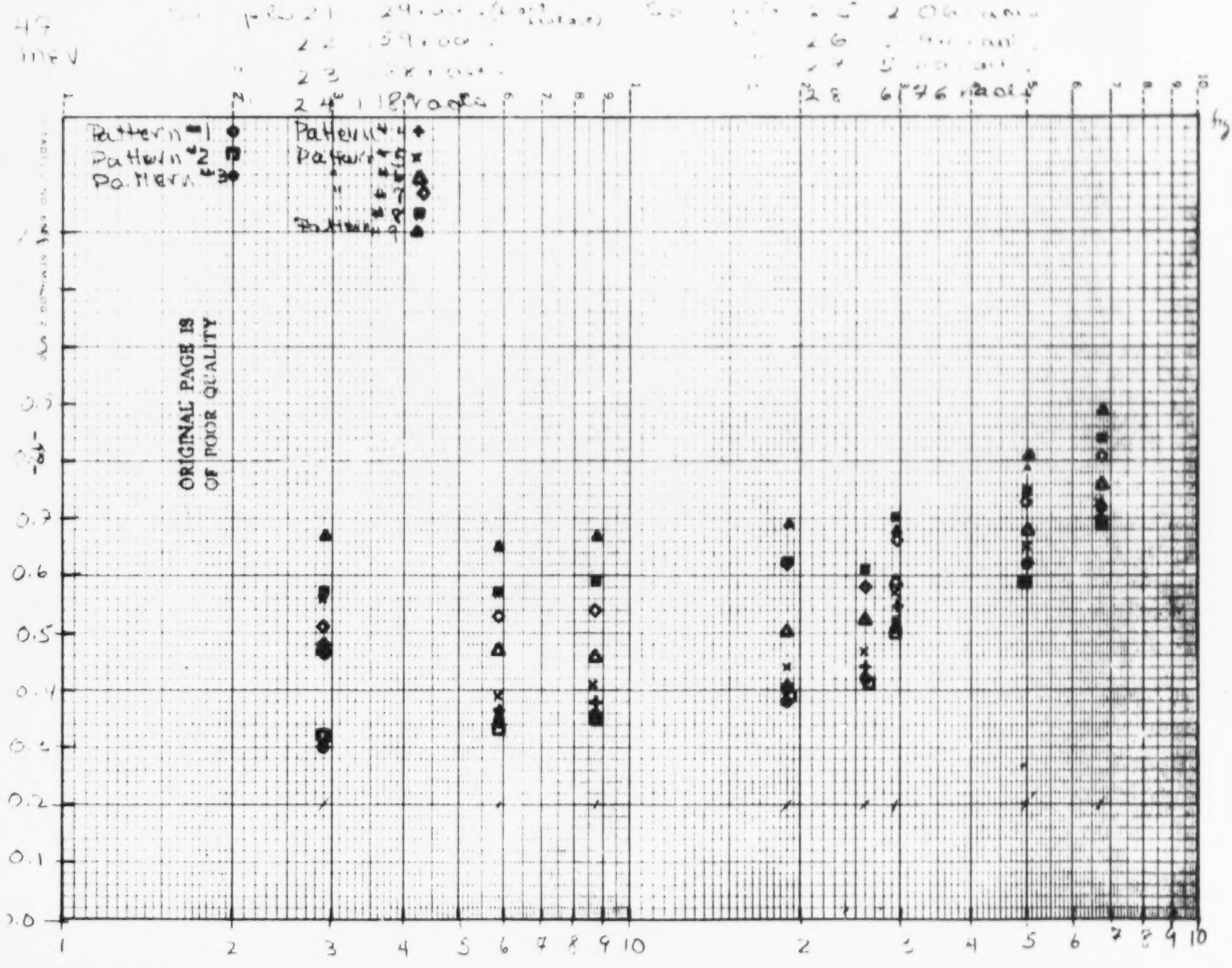



Pattern #10
Pattern #11
Pattern #15
Pattern #16
Pattern #17
Pattern #18
47 MEV
ROCK QUINTE


Pattern 1
Pattern 2
Pattern 3
Pattern 4
Pattern 5
Pattern 6
Pattern 7
Pattern 8
Pattern 9
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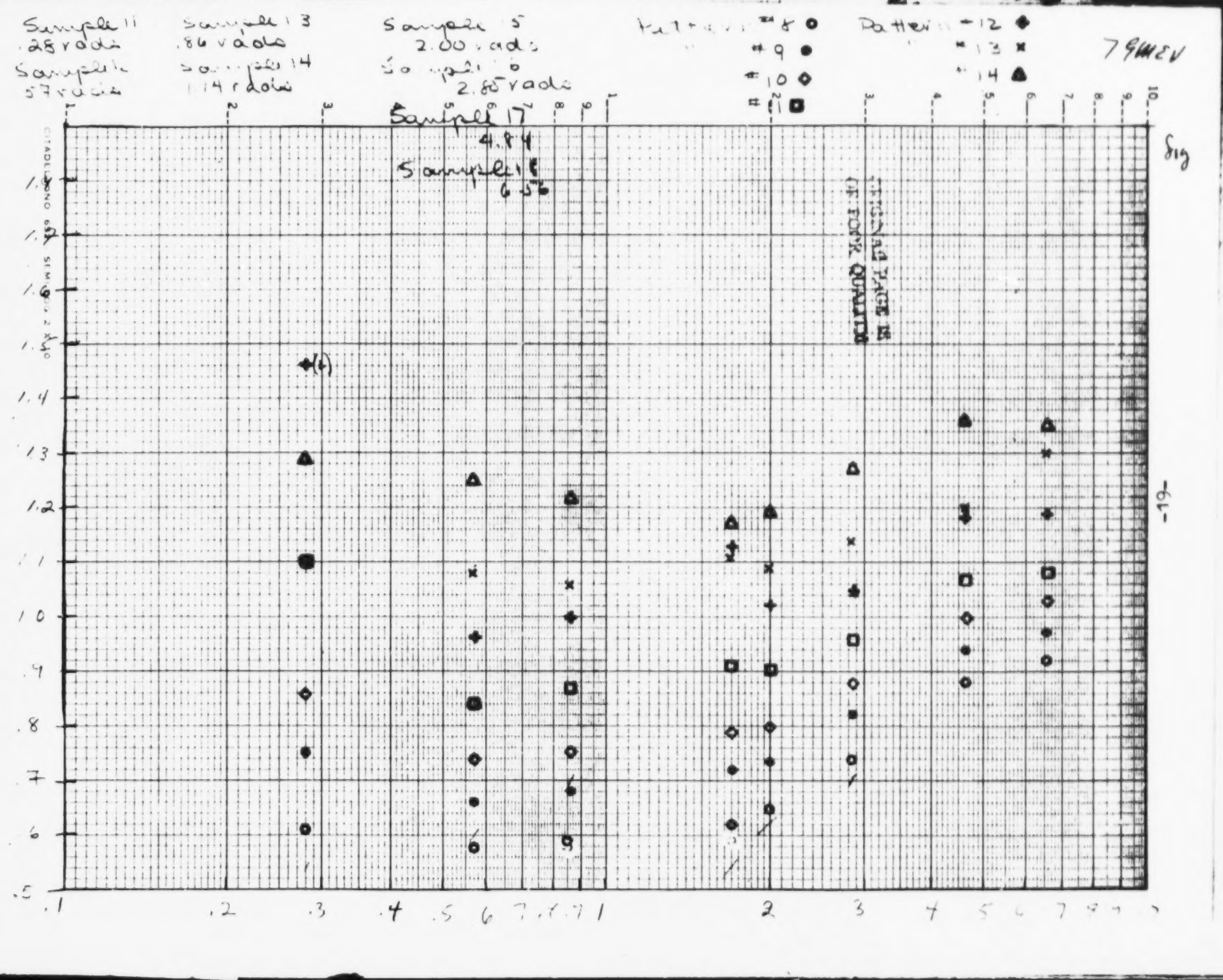
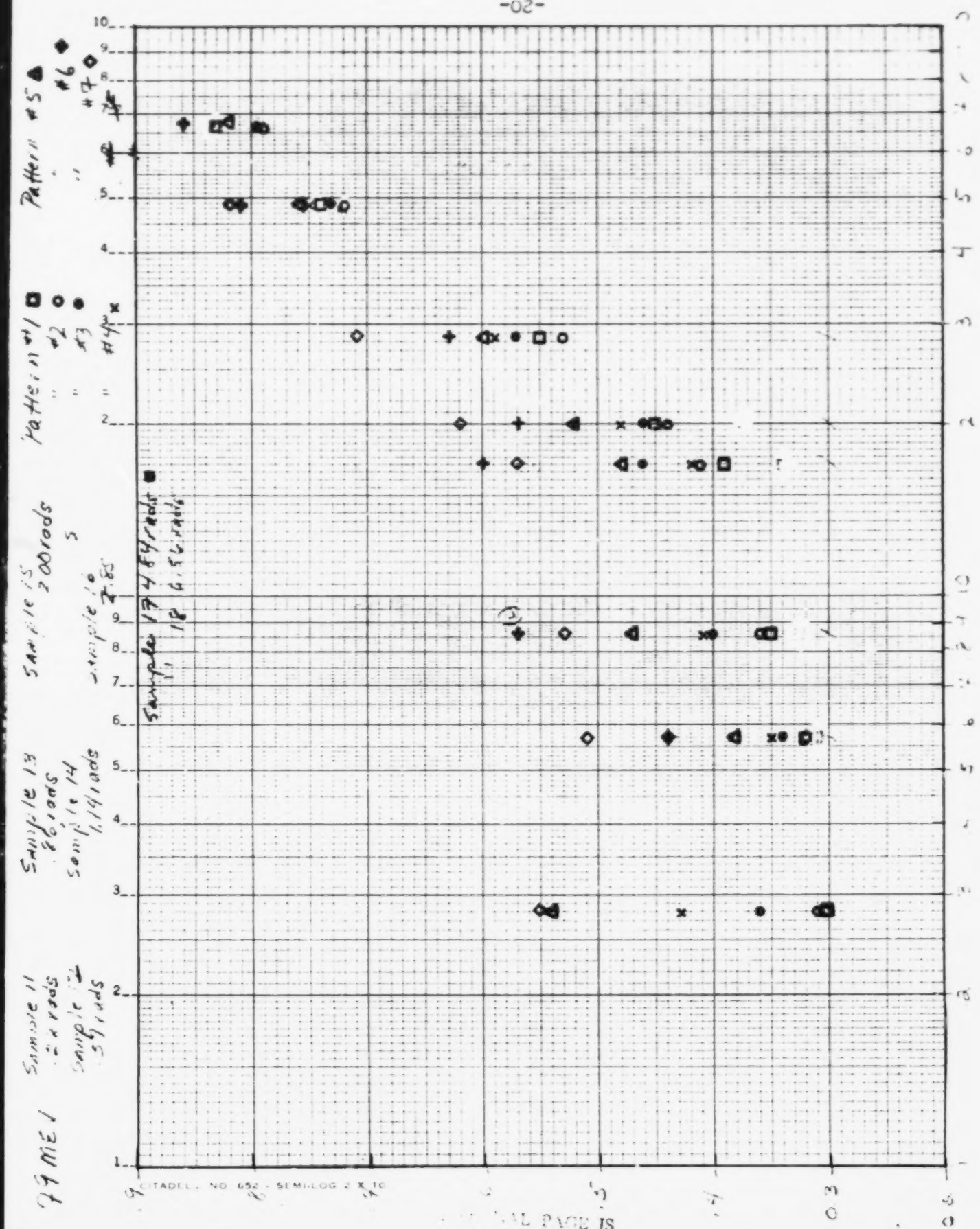
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
1
2
3
4
5
6
7
8
9
10


Sample 11
.28 rads
Sample 13
.86 rads
Sample 14
1.14 rads
Sample 5
2.00 rads
Sample 6
2.85 rads
Sample 17
4.84
Sample 16
6.56
Pattern #8
#9
#10
#11
Pattern #12
#13
#14
79MEV
Sig
-19-
CITADELLINO 50 SEMI-LOG 2 X 50
FISHER PAGE 16
OF FOUR QUARTERS



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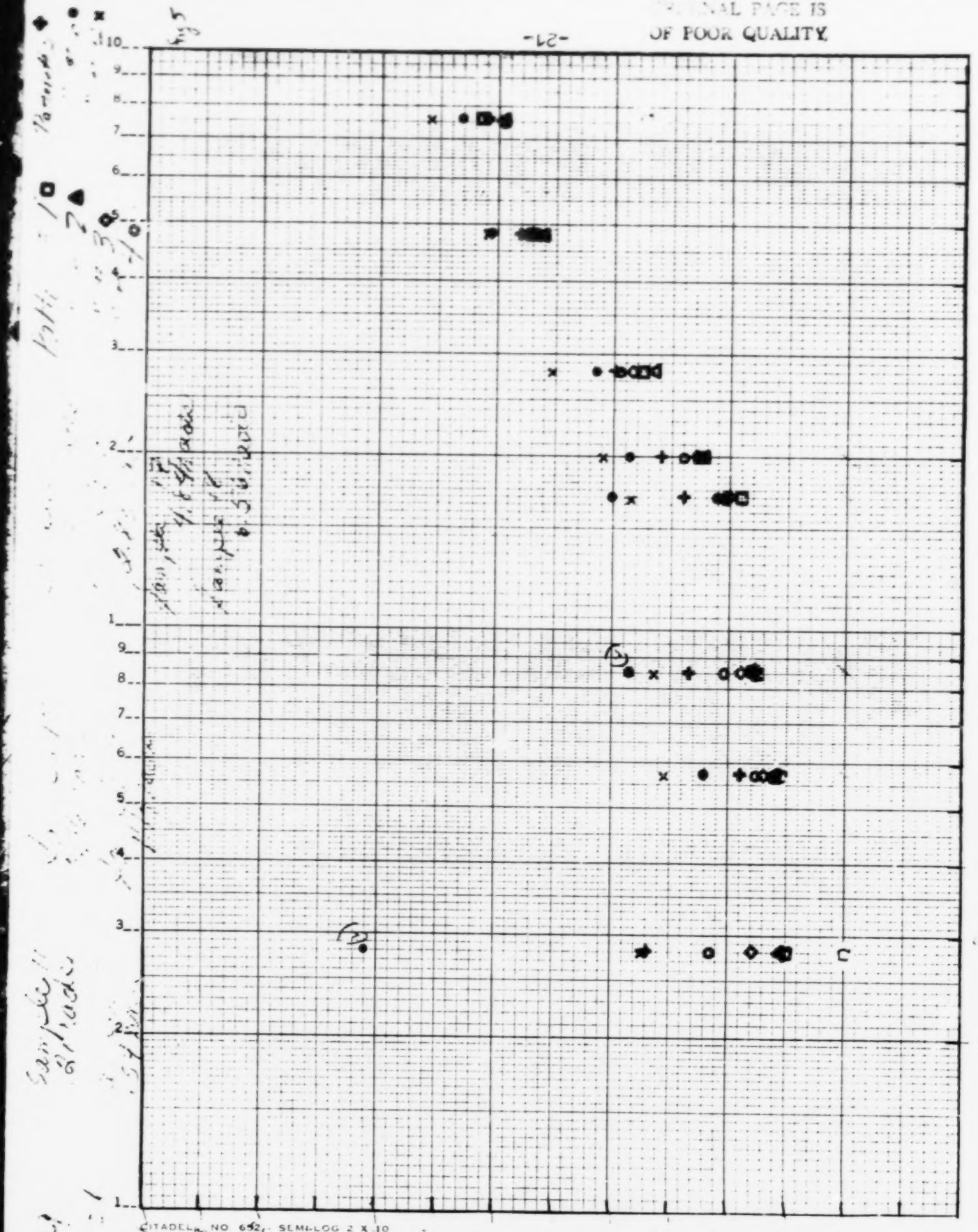

CITADEL NO 642 SEMI-LOG 2 X 10